International Journal of Trend in Scientific Research and Development (IJTSRD)
Volume 7 Issue 3, May-June 2023 Available Online: www.ijtsrd.com e-ISSN: 2456 – 6470

Effect of Essential Oil and Exogenous Enzymes on Blood Chemistry Profile and Antioxidant Capacity in Broiler Chickens

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ABSTRACT

The quality and safety of feed for broiler chickens are not only key factors to meeting production priorities but also improved health, hence the need to improve broiler chicken diet with alternatives to antibiotic growth promoters such as probiotics, essential oil and exogenous enzymes. This experiment was carried out to determine the effect of enzymes and essential oils combination in sorghum - based diet for broiler chickens. Three hundred and thirty (330) Ross broiler chicks were allotted to five (5) dietary treatments in three (3) replicates and each having twenty-two (22) birds respectively. The five treatments groups were fed with sorghum-based diet and sorghum-based diet with feed additives, which included Ronozyme® ProAct enzyme, Roxazyme® G2G enzyme, Axtra® XAP 101 enzyme and Biostrong® 510 15 % (essential oils) respectively. The result for serum protein showed that albumin levels were high in birds fed diets supplemented with multi enzyme (XAP) and essential oils, while values for lipid profile varied based on the different dietary treatment. The total antioxidant capacity showed that enzymes in combination with essential oils confer protection on the chickens via improved antioxidant capacity. It was concluded that the utilization of Biostrong® 510 15% and and exogenous enzymes in sorghum based diets improved the immunity of broiler chickens.

KEYWORDS: *Feed additives; Health; immunity; Sorghum*

How to cite this paper: Oladipo, M F | Onimisi, P. A | Abeke, F. O "Effect of Essential Oil and Exogenous Enzymes on Blood Chemistry Profile and Antioxidant Capacity in Broiler Chickens" Published in International Journal of Trend in Scientific Research and Development (ijtsrd), ISSN: 2456-6470, Volume-7 | Issue-3, June 2023, pp.218-222, URL: www.ijtsrd.com/papers/ijtsrd56330.pdf

IJTSRD56330

1. INTRODUCTION

Essential oils are important aromatic components of herbs and spices, which are used as natural alternatives for replacing antibiotic growth promoters (AGPs) in poultry feed as these have antimicrobial, antifungal, antiparasitic, and antiviral properties (Krishan and Narang, 2014). They have beneficial effects on poultry birds, including improvement of growth parameters through enhancement of feed stuffs, promotion of the bird's production performance, and improving the quality of product derived from them (Windisch *et al*., 2008).

Exogenous enzymes as growth promoters have been found efficacious with different mechanisms of action to help improve the production and gastrointestinal health poultry birds (Sethiya 2016). Base on the importance of feed enzymes, the poultry industry has become receptive to the use of exogenous enzymes.

Sorghum are cereals which are occasionally used in feed for broiler birds this is because the birds are unable to utilize the starch/energy present in the grains as a result of the presence of anti-nutritional factors present in the grains. Researches have shown that supplementation of sorghum baseddiet with feed additives can significantly improve the growth performance and nutrient digestibility of sorghum-based diets leading to better growth performance (Oladipo *et al*., 2019).

The exclusion of antibiotic growth promoters from poultry diets has generated wide interest in search for alternatives. Recently, many studies have focused on the effects of essential oils (EOs) and exogenous enzymes singly in animal diets and as substitutes of antibiotic growth promoters. However, few studies have compared the effect of supplementation of

essential oil and exogenous enzymes in sorghum-based diet therefore, the purpose of the current study was to evaluate the comparative effects of essential oil and exogenous enzymes on blood chemistry profile and antioxidant capacity of broiler chickens.

2. Materials and Methods

2.1. Experimental site

The experiment was conducted at the poultry research unit, National Veterinary Research Institute, Vom, Plateau State, Nigeria. The study area was located on Latitude 09° 44' N and Longitude 08°45' E with a physical feature of rocky granites of old volcanoes at altitude of 4200ft (1285m) above sea level with a mean annual rainfall ranged between 1300 to 1500mm and average daily temperature ranges between 17 ℃ to 28.6 ℃. The wet season extends from late April to middle October and relative humidity which ranges from 22% in January to 78% in July/August. Mean monthly sunshine hours ranges from 177288.3 (NVRI, 2022).

2.2. Experimental Design

Three hundred and thirty (330) broiler chicks were allotted to five (5) dietary treatments with three (3) replicates and each having twenty-two (22) birds in a completely randomized design (CRD) and were fed the following treatment diet.

T1 : Sorghum based diet

T2 : Sorghum based diet with Ronozyme® ProAct and Biostrong 510 15 %

T3 : Sorghum based diet with Roxazyme® G2 G and Biostrong 510 15 %

T4 : Sorghum based diet with Axtra® XAP 101 TPT and Biostrong 510 15 %

T5 : Sorghum based diet with Biostrong® 510 15 %

2.3. Statistical analysis

Data obtained in the experiment were statistically analysed using the General Linear Model procedure of statistical analysis software package. Significant differences between treatments means were separated using Tukey Post hoc Test. Values of $p<0.05$ were considered significant (SAS, 2002).

3. Results and Discussion

3.1. Haematological parameters of broiler chickens fed sorghum based diets with enzymes and essential oils in combination

The results for haematological parameters of broiler birds fed sorghum baseddiets with enzymes and essential oils combination are presented in Table 3.1. There were significant ($p<0.05$) differences in the values of the packed cell volume (PCV) although the values obtained were within the normal range of 22-35 % as reported by Jain (1993). PCV is the quickest indirect way of assessing values of red blood cells in circulation and is often used as a simple screening test for anaemia (Bashar *et al*., 2010). The haemoglobin (Hb) values recorded were all above the normal range except for T4 which was within the reference range of 7 to 13 g/dl. High concentration of haemoglobin in the cytoplasm of red blood cell gives an indication of effective oxygen carrying capacity of the blood. According to Oyawoye and Ogunkunle. (1998), values in the range of 7-15 g/dl indicated that the animal had sufficient blood pigments for efficient transportation of oxygen.

Table 3.1: **Haematological parameters of broiler chickens fed sorghum based diets with enzymes and essential oils in combination**

Parameters	T1	T2	T3	T4	T5	SEM
	Sorg	Sorg + ProAct + BSG	Sorg + G2G + BSG	Sorg + XAP+ BSG	Sorg + BSG	
PCV (%)	27.33^{b}	33.66^{a}	26.00^{b}	28.33^{b}	30.00^{b}	2.63
Hb (g/dL)	17.00^{ab}	14.33^{ab}	15.66^{ab}	10.33^{b}	18.60^{a}	1.69
RBC ($\times10^{6}$/L)	2.00	1.66	1.50	1.36	2.80	0.50
WBC ($\times10^{9}$/L)	3.80	3.90	3.50	3.63	4.00	0.52
Heterophils (%)	40.00	40.33	39.66	37.66	34.33	5.38
Lymphocytes (%)	58.00	57.66	59.66	61.66	63.66	4.55
Monocytes (%)	2.66^{a}	2.00^{a}	0.66^{b}	0.66^{b}	2.00^{a}	0.70
MCH (ρg)	85.00	86.33	104.40	75.96	66.43	1.97
MCV (fl)	136.65	202.77	173.33	208.31	107.14	30.26
MCHC (%)	62.20	42.57	60.23	36.46	62.00	0.59

a,b: Means with different superscripts on the same row are significantly different (P<0.05), SEM: Standard error of means, ProAct: Ronozyme® Proact enzyme, G2G: Roxazyme® G2G enzyme, XAP: Axtra® XAP 101 TPT enzyme, BSG: Biostrong® 510 15 %, PCV: Packed cell volume, Hb: Haemoglobin, RBC: Red blood cell, WBC: White blood cell, MCHC: Mean Corpuscular Haemoglobin Concentration, MCH: Mean Corpuscular Haemoglobin, MCV: Mean Corpuscular Volume

3.2. Serum proteins of broiler chickens fed sorghum based diets with enzymes and essential oils in combination

The result for serum proteins of broiler birds fed sorghum -based diets with and without enzymes and essential oils combination is shown in Table 2. The albumin levels in birds fed diets supplemented with multi enzyme and essential oils (T4) was significantly (P<0.05) higher compared to other dietary treatments (T1, T2, T3 and T5). This probably may be as a result of the multi enzyme content (xylanase, amylase and protease) with the combine effect of essential oils to release much of the binded protein and energy nutrient in the sorghum diet and the digestive enhancer activity of phenolic compounds of the essential oils which is a core mode of beneficial nutritional action (Basmacioglu *et al*., 2010)

Table 3.2: Serum proteins of broiler chickens fed sorghum based diets with enzymes and essential oils in combination

Parameters	T1	T2	T3	T4	T5	SEM
	Sorg	Sorg+ ProAct+ BSG	Sorg+ G2G+ BSG	Sorg+ XAP+ BSG	Sorg+ BSG	
Total protein (g/dl)	34.73	37.03	32.20	30.78	40.68	4.66
Albumin (g/dl)	16.56^{b}	16.18^{b}	15.47^{b}	19.11^{a}	16.84^{b}	2.23
Globulin (g/dl)	18.17	20.84	16.73	11.67	23.84	5.48
Albumin/Globulin ratio	0.91	0.78	0.93	1.74	0.83	0.38

a,b: Means with different superscripts on the same row are significantly different (P<0.05), SEM: Standard error of means, Sorg: Sorghum, ProAct: Ronozyme® Proact enzyme, G2G: Roxazyme® G2G enzyme, XAP: Axtra® XAP 101 TPT enzyme, BSG: Biostrong® 510 15 %

3.3. Lipid profile of broiler chickens fed sorghum based diets with enzymes and essential oils combination

The result for lipid profile is shown in table 3.3. The value for triglycerides showed significant (p<0.05) differences across treatments groups. Broiler chickens fed sorghum-based diets supplemented with feed additive had lower levels of triglycerides compared to those fed sorghum -based diet without feed additive supplementation. This result agrees with Kirkpinar *et al*. (2011) who reported that broilers fed with diets supplemented with oregano essential oils had significantly lower triglycerides level. This shows the cholesterol and triglycerides lowering activity of essential oils or plant extracts (Cross *et al*., 2003). The level of high density lipoprotein (HDL) in chickens fed sorghum based diet alone and sorghum based diet supplemented with enzymes and essential oil were higher compared to those fed Sorg+BSG diet. This shows that sorghum grain can improve animal health as it encourages the build-up of high density lipoprotein. The supplementation of sorghum-based diets with feed additives was found to cause a significant (p<0.05) decrease in the mean values of very low density lipoprotein (VLDL) of broiler chickens as compared to Sorghum based diet alone.

Table 3.3: Lipid profile of broiler chickens fed sorghum based diets with enzymes and essential oils combination

Parameters	T1	T2	T3	T4	T5	SEM
	Sorg	Sorg+ ProAct+ BSG	Sorg+ G2G+ BSG	Sorg+ XAP+ BSG	Sorg+ BSG	
Total Cholesterol (mg/dl)	149.10	138.43	137.30	128.23	134.56	26.07
Triglycerides (mg/dl)	92.39^{a}	65.99^{b}	57.24^{b}	54.57^{b}	39.84^{b}	25.34
HDL (mg/dl)	86.67^{a}	88.11^{a}	83.47^{a}	84.16^{a}	72.02^{b}	11.08
LDL (mg/dl)	43.93	37.12	42.38	33.15	54.57	26.76
VLDL (mg/dl)	18.49^{a}	13.20^{b}	11.44^{b}	10.91^{b}	7.97^{b}	5.06
Atherogenic index	148.10	137.43	136.30	127.23	133.56	26.07
Tg/HDL ratio	1.05^{a}	0.76^{b}	0.68^{b}	0.64^{b}	0.55^{b}	0.26

a,b: Means with different superscripts on the same row are significantly different (P<0.05), SEM: Standard error of means, Sorg: Sorghum, ProAct: ProAct: Ronozyme® Proact enzyme, G2G: Roxazyme® G2G enzyme, XAP: Axtra® XAP 101 TPT enzyme, BSG: Biostrong® 510 15 %, HDL: High density lipoprotein, LDL: Low Density Lipoprotein, VLDL: Very low density lipoprotein, Tg/HDL: Triglycerides/ High density lipoprotein ratio

3.4. Total antioxidant capacity of broiler chickens fed sorghum based diets with enzymes and essential oil in combination

The result for total antioxidant capacity of broiler chickens fed sorghum-based diet with enzymes and essential oil in combination is shown in table 4.

The glutathione (GSH) concentration showed significant ($p<0.05$) difference between the treatment groups. Chickens fed feed additives had high concentration of GSH. Glutathione is known to act as an antioxidant, a free radical scavenger and a detoxifying agent. Glutathione is also important as a cofactor for the enzyme glutathione peroxidase and helps in the uptake of amino acids (NCBI, 2023). The value for superoxide dismutase (SOD) and Malondialdehyde (MAD) showed no significant ($p>0.05$) difference across treatment groups.

Table 3.4: Total antioxidant capacity of broiler chickens fed sorghum based diets with enzymes and essential oil in combination

Parameters	T1 Sorg	T2 Sorg + ProAct + BSG	T3 Sorg+ G2G+ BSG	T4 Sorg+ XAP+ BSG	T5 Sorg+ BSG	SEM
GSH (µg/ml)	1.73^{c}	4.86^{b}	4.93^{b}	4.13^{b}	9.46^{a}	2.96
SOD (min/mg)	1.39	3.29	2.64	2.00	0.66	1.45
MDA (µmol/L/mg)	58.10	60.01	71.14	58.08	62.21	44.81

a,b,c Means with different superscripts on the same row are significantly different ($P<0.05$), SEM: Standard error of means, Sorg: Sorghum, ProAct: Ronozyme® Proact enzyme, G2G: Roxazyme® G2G enzyme, XAP: Axtra® XAP 101 TPT enzyme, BSG: Biostrong® 510 15 %, GSH: glutathione, SOD: superoxide dismutase, MAD: Malondialdehyde

Conclusions

The utilization of Biostrong® 510 15% and exogenous enzymes in sorghum-based diets was beneficial in modulating the immune and antioxidant defense systems of the birds and thus improving good health throughout the growth stage of the broiler chickens.

Acknowledgement

The authors wish to acknowledge the contributions of Agrited Nigeria (LTD) for providing the experimental birds and the multi enzyme (Axtra® XAP 101 TPT) a blend of Xylanase, Amylase and Protease, used for this research work.

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